CLAIMS

We claim:

1. A slow magic angle spinning probe useful for Magnetic Resonance Imaging and Spectroscopy, the probe comprising:
(a) at least one supporting (base) member;
(b) a shielding member attachably mounted to a said supporting member;
(c) at least one gradient assembly comprising a plurality of gradient coil(s) adapted to be housed within said shielding member attachably mounted to a said supporting member;
(d) an RF circuit assembly comprising at least one R.F. NMR coil(s) attachably mounted to a said supporting member;
(e) a rotor assembly adapted for spinning a specimen, said assembly disposed so as to be in optimum alignment with said gradient coil(s) and said NMR coil(s);
(f) a driving assembly operably connected with said rotor assembly for driving said rotor assembly; and,
(g) wherein said rotor assembly is rotatable about an axis positioned at a magic angle of 54.44° relative to an applied magnetic field Bo, and wherein spin speeds of less than 100Hz are applied.

2. The Probe of claim 1, wherein said shielding member further comprises ball bearings for mounting and rotating said rotor assembly.

3. The Probe of claim 1, wherein said gradient coils are selected from the group consisting of x-gradient coil(s), y-gradient coil(s), z-gradient coil(s), or combinations thereof.

4. The Probe of claim 1, wherein said R.F. NMR coil(s) is selected from the group consisting of bird cage coil(s), Alderman-Grant coil(s), surface coil(s), solenoid coil(s), inductance coil(s), or combinations thereof.

5. The Probe of claim 1 further comprising an optical detection system, a monitoring system, or combinations thereof.

6. The Probe of claim 5, wherein said monitoring system is a computer-controlled monitoring system for collection of sample measurement data such as temperature and pressure.

7. The Probe of claim 5 wherein said monitoring system is a respiratory monitoring system for use in respiratory-triggered NMR experiments.

8. The Probe of claim 5, wherein said optical detector system comprises a scintillation fiber.

9. The Probe of claim 1, further comprising a directional (axis) mechanism for adjusting a desired angle of said rotor assembly, wherein said mechanism is mountably attached to a said supporting member and operably connected with said rotor assembly;

10. The Probe of claim 1, wherein the specimen subjected to said MR imaging and spectroscopy is a member selected from the group consisting of fluid object, biological object, cells, cell aggregates, tissues, organs, live animals, or combinations thereof.

11. The Probe of claim 1 wherein said MR imaging and spectroscopy further comprises a member selected from the group consisting of PHORMAT, 2-D PASS.

12. The Probe of claim 1 wherein said MR Imaging and spectroscopy further comprises a sequence in the group consisting of DANTE, CHESS, water suppression sequence, or combinations thereof.

13. The Probe of claim 4, wherein said monitoring system further comprises a respiratory plethysmograph for monitoring respiration and respiratory motions of an animal.

14. The Probe of claim 1 further comprising an optical detector system having transistor-to-transistor logic pulse sequencing whereby said sequencing is adapted to trigger corresponding RF pulse sequencing in synchronization with precision markers mounted on said rotor assembly.

15. The Probe of claim 1 wherein said specimens are selected from the group consisting of fluid objects, biological objects, cell(s), cell clusters, tissues, organs, mounted specimens, live animals, and combinations thereof.

16. The Probe of claim 1 wherein said spinning is at a rate of up to about 40 Hz.

17. The Probe of claim 1 wherein said spinning and rotation is at a rate in the range from 0.01 Hz to about 40 Hz about said axis.

18. The Probe of claim 1, wherein said rotor assembly further comprises at least one cylinder(s) for housing an object or specimen.

19. The Probe of claim 1 wherein said rotor assembly further comprises a first and second cylinder, said second cylinder being adapted for insertion of an epoxy photopolymer cylindrical mold for mounting a specimen snugly fluid filled object within said rotor.

20. The Probe of claim 1, wherein said slow magic angle spinning is combined with RF pulse sequencing.

21. The Probe of claim 1, wherein said RF pulse sequencing comprises a sequencing protocol in the group consisting of: DANTE, CHESS, water suppression, or combinations thereof.

22. The Probe of claim 1, wherein said rotor further comprises ball bearings for stabilizing said rotor.

23. The Probe of claim 1, wherein said driving assembly further comprises at least one rotor pulley configured to spin said rotor in an optimal driving arrangement.

24. The Probe of claim 23, wherein said driving assembly further comprises three sets of pulleys for rotating the rotor assembly, a 1^{st} set comprising a single pulley, a 2^{nd} set comprising two pulleys, and a 3^{rd} set comprising a single pulley, wherein said pulley in said 1^{st} set is attached to said rotor, said 2^{nd} set has a single rotational axis whereby said pulleys rotate in opposite directions and whereby the axis of said 2^{nd} set of pulleys is perpendicular to the rotational axis of said 1^{st} set, and whereby said 3^{rd} set is operably connected to said driving motor.

25. The Probe of claim 1 configured for use as a constituent of a slow Magic Angle Spinning NMR, MRI, or CSI spectroscopy instrument.

26. The Probe of claim 1, wherein said small-sized objects are selected from the group consisting of excised tissues, organs, live bacterial cells, and biofilms.

27. The Probe of claim 26, wherein a spinning rate in the range from 30 Hz to 100 Hz is selected in combination with a PASS sequence.